EFFECTS OF GASOLINE PRICE LEVELS ON GDP PER CAPITA: A CROSS-COUNTRY ANALYSIS

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Abstract

The effects of the current fall in gas prices across the world are already being hypothesized. This paper attempts to establish the effects of gas price on gross domestic product (GDP) per capita in the year 2002 in 94 different world economies, with the hopes of isolating gas prices' overall effect on GDP per capita. This paper attempts to specifically isolate these two variables and then examine complementary factors that account for why certain periods of gasoline price changes affected the world in certain ways and what can be expected in the future with forecasted changes in those prices.

In addition to gas price, we observed the independent variables consumption, savings, government expenditure and exports (all as percentages of a country's GDP), as well as a dummy variable of exporter vs. importer which allowed the relationship between gas price and GDP to be further isolated. While this paper is based in economic theory and is related to the subject's previous literature, the paper also provides a unique view by focusing on the global effect of gas prices in a single year through cross-sectional analysis.

1. Introduction

Historically, a drop in gas prices has been accompanied by a boost in world GDP across many countries. It has also been noted to fuel additional consumer spending in many economies, as it is typically a good consumed by individuals. Currently, the United States is experiencing a period of falling gas prices domestically as we have identified new ways to source and distribute gasoline for our citizens.

With this in mind, we are trying to isolate the gas price change as a variable and observing the major contributors to GDP per capita. We chose gasoline price, instead of oil price because we are looking through a single year, cross-sectional approach instead of a time-series model, therefore we did not want to choose a variable like oil price that would be very similar for multiple countries. The difference between the two is gasoline is more associated with consumer spending and transportation rather than industrial purposes. Oil price is a definite factor, as gasoline is a by-product of oil. According to the US Energy Information Administration, worldwide, roughly 2/3 of the price of gasoline is determined by the price of oil. Therefore, the price of oil will not be absent from our study.

Recent and past studies have found there to be a negative correlation between oil prices and GDP. We hypothesize the relationship between gas prices and GDP per capita to be similar; therefore on average, we expect countries with higher gas prices to have lower GDP per capita. This is based on the idea that countries with higher gas prices will have decreased consumer spending along with a higher cost of transportation, travel and imports, all of which could potentially lead to a lower GDP per capita. This can be seen using even the most basic GDP formula, $Y= C+I+G+(X-M)$.

While attempting to find the relationship between gas price and GDP per capita, we chose the year 2002 because it is a recent example of an isolated decrease in gas prices worldwide that did not coincide with another large economic crisis, such as 2008's recession.

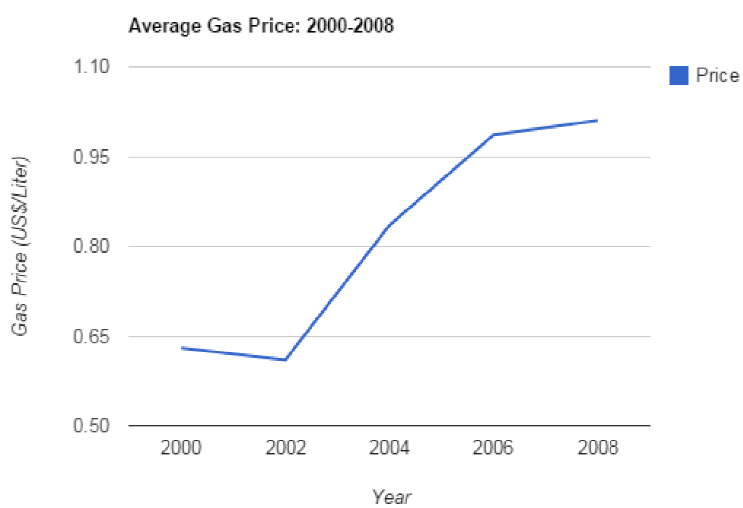
When taking the scenario of 2002, we find ourselves dealing with an international oil price decrease, some of the factors behind this involve political reasons - lower exports from Iraq, potential of war, and crackdowns on surcharges by the UN. With most exports coming from the Middle East, it was an uncertain time as to their investment and pricing policies that would be implemented. According to the World Bank, as prices fell, on average, by 1.7% between 2000 and 2002. For instance, in the United States, price fell from an average of $.47 a liter to $.40 a liter.

According to CESinfo Economic Studies(2002), at the time, oil prices were, in the long term, expected to fall down to $22-$24/b, which would have led to even lower gas prices. However, the opposite happened and by 2008, gas prices had on average doubled, to a new global average price of $1.01.

Overall, we hope that by examining the effects on GDP per capita as a whole, in multiple different countries and nations, we can form conclusive results that will be applicable to other situations in which the gas price level may affect GDP per capita, both in past like in the 1970's oil crisis, and also to forecast what may happen in the future; for example, we are currently undergoing a decline in prices now, primarily in the US.

Our model is significant because unlike previously conducted time-series models, our model looks cross-sectionally at a gas prices effect on GDP per capita, which allows us to isolate this effect for a single year. Furthermore, our model adds to the current literature because it takes into account not only those factors which affect GDP, but also each country's population, land area and reliance on the road sector. This is important because we are now able to analyze each country's gas prices effect on GDP without needing to, possibly wrongly, assume that the countries are equal in terms of land area or reliance on transportation.

Figure 1. Average Global Gas Price from 2000-2008



2. Literature Review

Much research has been devoted to this subject over the last 40 years in finding proper and sustainable correlations among these two variables in countries of the world.

We begin with James Hamilton's(1988) study of the effects of oil price changes on the macroeconomy. As a forefront academic on this subject, he laid the foundation which explains that there was a negative correlation between oil prices and GDP, finding that the forces accounting for this are based on short run cyclical consequences such as recessions, and that the effects of energy shortfalls should be bounded by energy's dollar share of GDP. However, these findings were concluded mainly on a convincing stability of elasticities upon the price rises of the 1981-1985 period, which placed some constraint on the extrapolation of these conclusions on other years with other exogenous changes in GDP and productivity.

After this period, others were curious as to whether his findings would hold true for other periods, mainly those in which prices decreased, leading to an asymmetric effect of increases versus decreases on GDP. Observing this involved stability tests while separating price increases and decreases as separate variables, testing individual significance and correcting for price controls. Knut Mork (1989) found that effects of declines are different than increases, accounting for a smaller portion of changes in GDP.

Since then, many have observed accordingly that the oil price-GDP relationship is asymmetrical, and some found that there were weakening effects of oil price variations on GDP growth rate. Sabhi Farhani (2012), through linear regression modeling, found that there is a possibility that oil price *levels* do not specifically affect economy, but *variations* do, using: $DLN(GDP_t) = \alpha + \beta DLN(OILPRICE_t) + \varepsilon_t$ and $DLN(GDP_t) = \beta DLN(OILPRICE_t) + \varepsilon_t$. Farhani's findings related specifically to the United States, but we could find analogies between her processes and methodology to extend to other countries as well. There are also known to be variations among the correlation pattern from country to country, although not very strongly. Mork observed that, for example, although the US is not one of the most oil-dependent countries, it does experience relatively higher vulnerability, in which case it can be seen that the net-export position of a country has significant effects on the oil-price and GDP relationship, provided that oil is a significant portion of the economy.

Our paper takes into consideration the research done on the topic from these explained different angles and focuses on the fundamental effects of gas price levels, and consequently oil price levels, on GDP per capita with the more recent situation of 2002 in mind. We chose accompanying variables that we thought would create a more robust understanding of the effects, namely from a consumption perspective, as that is the angle that we found to be the most realistic approach to take when looking at gasoline. The ideas of transportation needs and demands based on the population and collective consumption data would provide meaning to the effect of gas price on GDP. Since demand for gas prices come from individual consumption and vehicle proliferation in a country, we wanted to account for these internal differences as well as countries' overall saving and percentage of gasoline imported or exported to also account for international and global factors.

3. Data

All of the data we used in our analysis was obtained through the Word Bank's databank of global indicators.

3.1 Variables included in Simple Regression

Our simple regression is as follows:

$$\boldsymbol{loggdpp = \beta_0 + \beta_1 gas2002}$$

1. *loggdpp:* Our dependent variable is equal to the log of the GDP per capita in billions of US$. The US$ is based on the exchange rate for the period in which the data was collected. We chose to take the log of GDP per capita instead of looking at GDP per capita discretely because we wanted to see what percent the GDP would change by from a small change in gas price.
2. *gas2002:* Gas price is represented as US$/Liter based on each country's exchange rate for the period in which the data was collected.

3.2 Variables Included in Multiple Regression

We also included several other variables in our analysis, so that we could further and more accurately isolate the relationship between gas price and GDP per capita through a multivariable regression analysis. Originally, we included eight variables, but after looking at their significance levels, narrowed this number down to five. We used a more general model before analyzing the variables further and conducting robustness tests, which will be explained in section 4, then arriving at the following model. Therefore, our multiple regression is as follows, along with the explanation of what each variable represents and our reasoning for choosing them:

Original: $loggdpp = \beta_0 + \delta_0\ importer + \beta_1 gas2002 + \beta_2 logcons + \beta_3 logsav + \beta_4 loggovt + \beta_5 logexp + \beta_6 land + \beta_7 logroad$

Final: $loggdpp = \beta_0 + +\beta_1 gas2002 + \beta_2 logcons + \beta_3 loggovt + \beta_4 logexp$

1. *loggdp:* same as simple regression
2. *gas2002:* same as simple regression
3. *importer:* This is a dummy variable created to differentiate between the oil exporting and oil importing countries. It is based off of the percent of fuel imported versus exported, where countries exporting less than 50% of their fuel are designated with "1." Our benchmark in this case are “exporter” countries who export more than 50% of their fuel.
4. *logcons:* This is the log of the percent of GDP from consumption in US$ in the year 2002. US$ is based on the exchange rate from the period in which the data was taken. We took the log of the consumption because it is a percentage, and thus a continuous variable. We also chose this variable, along with our savings, government expenditure, and net export variable based on the classic GDP equation $Y= C+I+G+NX$.
5. *logsav:* This is the log of the percent of GDP from savings in US$ in the year 2002. US$ is based on the exchange rate from the period in which the data was taken. We chose savings because the World Bank did not have data on the percent of GDP of investment in countries and because at long term equilibrium, savings should equal investment.We took the log of the savings because it is a percentage, and thus a continuous variable.
6. *loggovt:* This is the log of the percent of GDP from government expenditure in US$ in the year 2002. US$ is based on the exchange rate from the period in which the data was taken. We took the log of the government expenditure because it is a percentage, and thus a continuous variable.

7. *logexport:* This is the log of the percent of GDP from net exports in US$ in the year 2002. US$ is based on the exchange rate from the period in which the data was taken. We took the log of the net exports because it is a percentage, and thus a continuous variable.
8. *land:* This variable is equal to the total surface area of the country in 100,000 kilometers. We chose this variable as a way to account for differences between large countries, where oil based transportation is likely more necessary, and smaller countries.
9. *logroad:* This variable is equal to the percent of total energy consumption from the road sector for each country. We chose to include this variable because we wanted to differentiate between countries that relied heavily on "road sector" transportation, such as cars and buses, and those who do not. Because this variable is also a percentage, we took its log instead of analyzing it discretely.

Appendix 1 provides a list of all of the countries we had used. We were required to narrow down the list of countries we used because with the variables we had chosen, we wanted to make sure we had no gaps or missing variables, while still keeping a sufficient amount of observations to work with.

Figure 2. Descriptive Statistics

Variable	Obs.	Mean	Std. Deviation	Minimum	Maximum
loggdp	94	7.84694	1.56378	4.72062	10.8657
gas2002	94	.635213	.272001	.07	1.470
importer*	94	.180851	.386959	0	1
logcons	94	4.14279	.227885	3.26097	4.51764
logsav	94	2.96529	.4137993	1.59349	3.81173
loggovt	94	2.67543	.3749118	1.60973	3.59811
logexport	94	3.44686	.553228	1.9509	4.99289
logroad	94	2.53393	.610531	.253665	3.56841
land	94	24.3961	67.89244	.007	514

*dummy variable

3.3 Gauss- Markov Assumptions

We can be sure that we are able to use a multiple linear regression model for this data because it meets the five Gauss-Markov assumptions.

1. *Linear in Parameters*

   The first assumption, that the data is linear in parameters is satisfied because we will not manipulate the independent (gas price, consumption, saving, and others) and dependent (GDP) coefficients except by multiplying them by constants, which is a linear change. Even by using logarithms on certain variables, we made sure that all parameters were related together in a linear fashion.

2. *Random Sampling*

   The data can assumed to be collected from random samples, even though we did not collect the data first hand, because all the data we used was collected by the World Bank.

3. *No Perfect Collinearity*

   We have also satisfied the third assumption because we chose more than one independent variable.

   As shown by Figure 3, because none of the independent variables are perfectly correlated with each other, we can assume that the third assumption holds. We have chosen variables such that one variable cannot be perfectly predicted from any combination of the others.

Figure 3. Cross-correlation between independent variables

	loggdp	**gas2002**	**Logcons**	**logsav**	**loggovt**	**logexport**	**logroad**	**land02**	**export**
Loggdp	**1.0000**								
gas2002	**.4167**	**1.0000**							
Logcons	**-0.5943**	**0.0424**	**1.0000**						
Logsav	**0.4425**	**-0.0256**	**-0.6917**	**1.0000**					
Loggovt	**0.5363**	**0.1802**	**-0.5526**	**0.2173**	**1.0000**				
Logexport	**0.4862**	**-0.0211**	**-0.5290**	**0.3512**	**0.2513**	**1.000**			

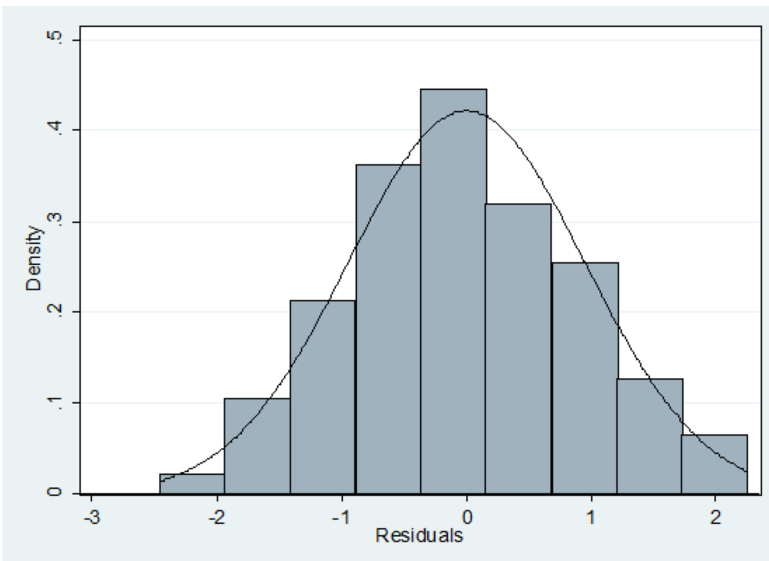
Logroad	**0.2083**	**0.1871**	**-0.2257**	**0.0599**	**0.1863**	**0.0543**	**1.0000**		
land02	**0.0920**	**-0.0906**	**-0.0761**	**0.0999**	**0.0878**	**-0.1431**	**0.0446**	**1.0000**	
importer*	**-0.0969**	**-1.1595**	**-0.0049**	**0.0350**	**-0.567**	**-0.1619**	**-0.0007**	**0.0875**	**1.0000**

*dummy variable

4. *Zero Conditional Mean*

The fourth assumption of zero conditional mean independence can be assumed because, as will be shown later in our multiple linear regression model, the relationship between GDP per capita, gas price, and other independent variables can be shown through a linear equation with a y-intercept, slope coefficients and an unobserved variable with an expected value of 0: $\boldsymbol{y = \beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + u}$.

Figure 4. Histogram of residuals with zero conditional mean



Also, as shown in Figure 3.2, a plot of the residuals follows a normal distribution with a mean of zero.

5. *Homoscedasticity*

The fifth assumption of homoscedasticity implies that given the independent variable x, y and u have the same variance, σ^2. This can be found by making sure the correlation of each variable is less than 1, meaning that the variables do not depend on each other so therefore the variance of Y given X and U given X can assumed to be a constant, σ^2.

Therefore, all of the Gauss-Markov assumptions hold meaning; with our data, the best linear unbiased estimators of the coefficients are given by the ordinary least squares (OLS) regression model.

4. Results

4.1 Simple Regression: Results

First, we regressed the log of GDP and gas price to find its simple relationship. In this regression, all other factors contributing to GDP other than gas price are included in the error term *u*, so it is clearly not the most accurate depiction of gas prices effect on GDP. Our equation is as follows:

$$\boldsymbol{loggdp = 6.29701 + 2.41708gas2002 + u}$$

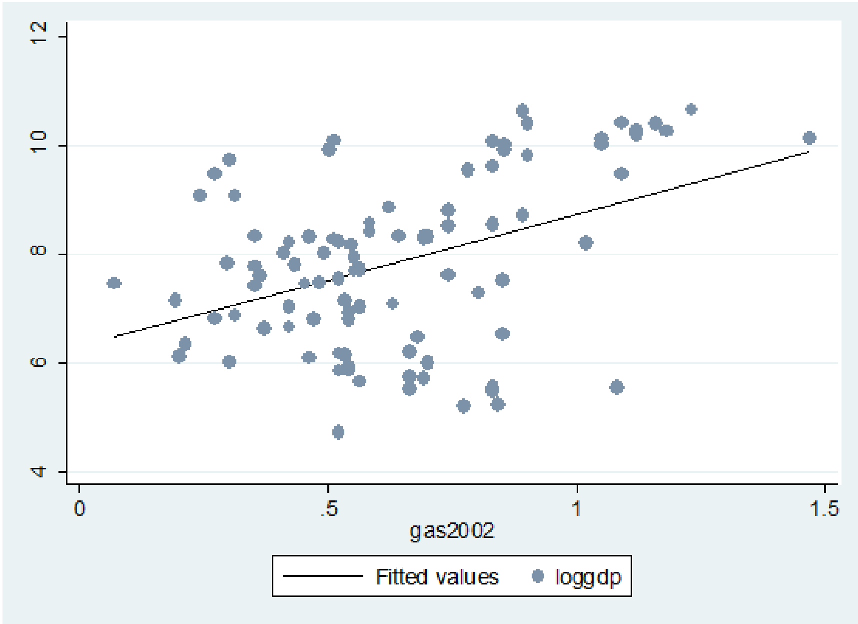
This regression has an R^2 of .1799, meaning 17.99% of the variation in *loggdp* can be explained by gas2002. Furthermore, our two coefficients have very high t statistics, meaning their interaction is significant.

Figure 5. Table showing significance of simple regression variables

Variable	t-stat	p-value
gas2002	4.61	0.000
β_0	17.56	0.000

Even though our variables are clearly significant, the model does not always make logical sense. Basically, it is saying that if there were no gas prices in a country, the log of the GDP per capita would be 6.29 which equals about \$540. But, when gas price is included, the model becomes more realistic. For every additional US dollar of gas price, the GDP per capita increases by \$2.42. For instance, f the gas price were \$1/L, the GDP per capita would be \$6063.24 While this may appear low, many countries, particularly developing countries, have GDP per capitas similar or even lower.

Figure 3. Simple Linear Regression: GDP and gas price for 2002



4.2 Multivariable Regression: Results

We carried out a multivariable regression first without a dummy.

As explained before in section 4.2, our multivariable regression consisted of the variables listed there, and upon regression, our equation was as follows (coefficients are rounded to two decimal places):

$$loggdpp = 6.58 + 2.36gas2002 + .81logexp - 1.69logcons + .47logsav + .92loggovt + .02logroad + .0027land$$

Figure 6. Statistical Significance of Variables (t-statistic)

Variable	T-Statistic
Gas2002	**5.73**
Logexp	**3.52**
Logcons	**-1.91**
Logsav	**1.28**
Loggovt	**2.52**
Logroad	**.12**
Land02	**1.21**

Figure 7. Statistical Significance of Variables (P-Value)

Variable	P-Value(95% confidence interval)
Gas2002	0
Logexp	.001
Logcons	.060
Logsav	.203
Loggovt	.014
Logroad	.904
Land02	.089

By observing each variable's corresponding t-statistics and p-values, the results show the statistical significance of each, upon which we conducted tests and modifications to better understand how the variables interact. We can see that *gas2002* has the most significant effect of the variables, seen both in a large t-statistic and significant p-value at the 5% level, which is as we had hoped; also by observing the magnitude of the coefficient, giving it an important role in the effect on GDP per capita. We can believe now that it has both a statistical and economic significance.

We were expecting *land* and *logroad* to have a relatively low significance, which is strengthened by the fact that their p-values are greater than the critical value at the 5% significance level.

The presented insignificance of *logsav* and *logcons* was a little more surprising, as was *logexp*, prompting us to explore specifically *logexp* further. With the idea that consumption, and consequently saving, would have an impact on the spending of gasoline in any given country, we expected that *logsav* and *logcons* would present some significance in our model. In the next section, we will explain how we constructed another modified model to study *logexp*, in which we used a binary dummy variable to account for the potential differences that may arise when a country is seen as a heavy exporter versus importer of gasoline.

We found that we had an acceptable R^2 of 0.6369, which means that 63.69% of the variance in *loggdp* can be explained by our model. Although the caveat with this is that it may have risen in some part to our addition of variables, we believe that with the consistent and realistic nature of the coefficients, p-values, and t-values, we can accept this as a good indicator of the explanatory nature of the model.

Before moving further, we also constructed a robustness, or F-test, on this model, attempting to study the joint significance of the variables *land*, *logsav*, and *logroad*. Although consumption was insignificant based on t-statistics, we decided to keep it in our model instead of savings because economically, consumption and investment have the greatest effect on aggregate expenditure and thus GDP per capita. Also, as seen in Figure 3, *logcons* and *logsav* have the greatest cross-correlation (.697), meaning it is very likely that some of *logcons* significance is being lost due to *logsav*. Therefore, our restricted model became:

$$loggdpp = 12.37 + 2.33gas2002 + .71logexp - 2.58logcons + .84loggovt$$

Upon calculating an F-test between the unrestricted and restricted models, we found that our F-value of 1.89 was smaller than our critical value of 2.71, making the three variables jointly insignificant as we accept the null hypothesis that:

$$H_0: \beta_{logroad} = 0, \beta_{logsav} = 0, \beta_{land} = 0$$

Therefore, our final multiple regression model is our restricted model.

We now proceed to modify the model as explained before by distinguishing between exporter versus importer as a classification using a binary dummy variable. We take this step to further define the scope of our model and account for particular differences that may help determine specific factors of a country's position in the international gasoline market that would more strongly affect GDP per capita in a distinct way.

In our research, we noticed that there was a noticeable difference in data points between countries who are oil exporters and those who are oil importers. Economically, this makes sense because countries who are oil exporters should benefit from a rise in gas prices, due to the their increase in revenue from selling oil at a higher price would outweigh the fall in consumption due to higher gas prices. The opposite is true for oil importers, whose GDP per capita would simply fall from a higher oil and thus higher gas price because they would not receive any additional revenue from the higher prices.

To prove this hypothesis, we constructed the dummy variable *importer*, which is based off of the percent of fuel imported versus exported in a country for the year 2002. If a country exported less than 50% of its fuel, we designated it as an "importer." In our regression with the dummy variable, we set "exporter" as the benchmark. This way, each oil exporting country was given the value 0, while importers were given the value 1. After this, our regression was as follows:

loggdp = 13.67304 +2.392364gas2002 -2.76475logcons +.629577loggovt +.7153746export -.0553757importer

This equation is similar to what we expected because the variable *importer* has a negative coefficient, meaning that being an oil importer has a negative effect of *loggdp* when there is an increase in gas price. Unfortunately, though, our dummy variable is not significant (t-stat: -0.21, p-value: .836), so its effect on *loggdp* so the null hypothesis that being an oil importer or exporter has no effect cannot be rejected. Because we cannot reject the null hypothesis, further analysis of the differences in GDP per capita caused by gas prices between importing and exporting countries is not necessary and would potentially confound our results. Due to the statistical insignificance of our dummy variable, our final model is our restricted multivariable model seen on page 13.

5. Conclusion

Before conducting our research, we hypothesized that due to a fall in consumption and an increase in cost of inputs due to high gas prices, countries experiencing higher gas prices would also experience and lower GDP per capita. Based on our results, our original hypothesis was wrong and the actual relationship between gas price and GDP is opposite of what we expected.

Furthermore, our original hypothesis that gas prices would affect the GDP per capita of oil exporting and importing countries differently was also incorrect.

Through our research, we are able to conclude that there is a positive relationship between gas price and GDP per capita. Economically, this means that countries with higher gas prices, on average, also have a higher GDP. However, we do not believe this is a casual relationship. Rather, we are able to conclude, based on the available literature and our ability to reject our original hypothesis, that countries with higher GDP per capitas also have infrastructure that keeps gas prices high, such as government subsidies or taxes. This relationship appears to be stronger than the adverse effect that lower consumption would have on GDP per capita. We would have liked to analyze this relationship further, but the large number of missing data points for infrastructure variables in the World Bank database would have greatly reduced our number of data points, and thus our degrees of freedom and statistical significance.

Even more, by finding that a country's reliance on the road sector and the total land area of a country have a statistically insignificant effect on GDP per capita, we are able to further show that it is not gas prices effect on demand or consumption that effects GDP per capita. For instance, we originally believed that countries with large land area should rely more on gasoline for travel and those countries should have lower GDP per capitas if it also had high gas prices. Our model is important, though, because it is able to prove this relationship does not hold. While our model cannot show whether a rise in gasoline prices will lead to a rise in GDP per capita or not, we can conclusively say that countries with higher gas prices also have high GDP per capita, which is both statistically and economically significant. Since we have chosen a relatively recent, and single, time period to study this relationship, we believe that these findings will be useful when observing what truly happens with current and future trends in the relationship between GDP per capita and gas price.

6. References

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7. Appendix

7.1 List of Countries

Albania	**Croatia**	**Korea, Rep**
Arab World*	**Indonesia**	**Latin America***
Armenia	**India**	**Sri Lanka**
Australia	**Ireland**	**Lithuania**
Azerbaijan*	**Iceland**	**Latvia**
Benin	**Israel**	**Madagascar**
Burkina Faso	**Italy**	**Mexico***
Bangladesh	**Jamaica**	**Macedonia**
Bahrain*	**Jordan**	**Mali**
Brazil	**Kazakhstan**	**Malaysia**
Brunei Darussa*	**Kenya**	**Namibia**
Botswana	**Korea, Rep**	**Niger**
Canada	**Latin America**	**Nigeria**
Central Europe	**Sri Lanka**	**Nicaragua***
Switzerland	**Euro Area**	**Netherlands**
Chile	**Estonia**	**Norway**
China	**Ethiopia**	**Nepal***
Cote d'Ivoire	**European Union**	**Oman**
Cameroon	**Finland**	**Pakistan***
Costa Rica	**France**	**Panama**
Cyprus	**Gabon**	**Peru**
Denmark	**United Kingdom**	**Poland**
Dominican Rep	**Greece**	**Paraguay**
East Asia and Pacific	**Guatemala**	**Russian Federation**
Ecuador	**Guyana**	**Rwanda***
Egypt	**Spain**	**South Asia**
Euro Area	**Hong Kong**	**Saudi Arabia**
Estonia	**Honduras**	**Sudan***
Ethiopia	**Hungary**	**Suriname**
European Union	**Croatia**	**Slovak Republic**
Finland	**Indonesia**	**Syrian Arab Republic***
France	**India**	**Togo**
Gabon	**Ireland**	**Thailand**
United Kingdom*	**Iceland**	**Turkey**
Greece	**Israel**	**Uganda**
Guatemala	**Italy**	**Ukraine**
Guyana	**Jamaica**	**Uruguay**
Spain	**Jordan**	**Yemen***
Hong Kong	**Kazakhstan**	**South Africa**
Hungary	**Kenya***	

*Oil exports were greater than oil imports in the year 2002

7.2 STATA Output

Simple Regression Model

```
. regress loggdp gas2002

      Source |       SS       df       MS              Number of obs =      99
-------------+------------------------------           F(  1,    97) =   21.28
       Model |  42.2591274     1  42.2591274           Prob > F      =  0.0000
    Residual |  192.596644    97  1.98553242           R-squared     =  0.1799
-------------+------------------------------           Adj R-squared =  0.1715
       Total |  234.855772    98  2.39648747           Root MSE      =  1.4091

------------------------------------------------------------------------------
      loggdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     gas2002 |   2.417073   .5239235     4.61   0.000     1.377229    3.456916
       _cons |   6.297066   .3586354    17.56   0.000     5.585274    7.008858
------------------------------------------------------------------------------
```

Multiple Regression Model

```
. regress loggdp gas2002 logcons logsav loggovt logexport logroad land02

      Source |       SS       df       MS              Number of obs =      90
-------------+------------------------------           F(  7,    82) =   20.54
       Model |  140.208452     7  20.0297789           Prob > F      =  0.0000
    Residual |  79.9483579    82  .974979975           R-squared     =  0.6369
-------------+------------------------------           Adj R-squared =  0.6059
       Total |   220.15681    89  2.47367202           Root MSE      =  .98741

------------------------------------------------------------------------------
      loggdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     gas2002 |   2.361745   .4122202     5.73   0.000     1.541707    3.181782
     logcons |  -1.698923   .8905103    -1.91   0.060    -3.470431    .0725858
      logsav |   .4760632    .370937     1.28   0.203    -.2618487    1.213975
     loggovt |   .9253977   .3666902     2.52   0.014     .1959341    1.654861
   logexport |   .8075084   .2294673     3.52   0.001     .3510248    1.263992
     logroad |   .0223929   .1853173     0.12   0.904    -.3462622     .391048
      land02 |   .0026993   .0015696     1.72   0.089    -.0004231    .0058218
       _cons |   6.583228   5.436024     1.21   0.229    -4.230755    17.39721
------------------------------------------------------------------------------
```

Restricted Multiple Regression Model

```
. regress loggdp gas2002 logcons loggovt logexport
```

Source	SS	df	MS
Model	145.625322	4	36.4063305
Residual	89.2304498	94	.949260104
Total	234.855772	98	2.39648747

Number of obs =	99
F(4, 94) =	38.35
Prob > F =	0.0000
R-squared =	0.6201
Adj R-squared =	0.6039
Root MSE =	.9743

loggdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gas2002	2.384802	.3716804	6.42	0.000	1.646822	3.122782
logcons	-2.778722	.5863465	-4.74	0.000	-3.942926	-1.614517
loggovt	.6242692	.2960816	2.11	0.038	.0363922	1.212146
logexport	.7088141	.208719	3.40	0.001	.2943977	1.123231
_cons	13.72652	3.279388	4.19	0.000	7.215219	20.23782

Restricted Model with Dummy Variable

```
. regress loggdp gas2002 logcons loggovt logexport importer
```

Source	SS	df	MS
Model	145.666752	5	29.1333504
Residual	89.1890197	93	.959021718
Total	234.855772	98	2.39648747

Number of obs =	99
F(5, 93) =	30.38
Prob > F =	0.0000
R-squared =	0.6202
Adj R-squared =	0.5998
Root MSE =	.9793

loggdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gas2002	2.392364	.375354	6.37	0.000	1.646985	3.137743
logcons	-2.76475	.5931746	-4.66	0.000	-3.942678	-1.586823
loggovt	.629577	.2986937	2.11	0.038	.0364305	1.222724
logexport	.7153746	.2121506	3.37	0.001	.2940855	1.136664
importer	-.0553757	.2664256	-0.21	0.836	-.5844441	.4736927
_cons	13.67304	3.306236	4.14	0.000	7.107508	20.23857